

What is claimed is:

1. A method of fabricating a semiconductor device comprising the steps of:
 - (a) forming a trench in a semiconductor substrate having a first semiconductor region of a first conductivity type, from a major surface of the semiconductor substrate in a depth direction thereof;
 - (b) forming a gate insulating film including a thermal oxide film and a deposition film over the internal surface of the trench;
 - (c) forming a gate electrode over the gate insulating film in the trench; and
 - (d) introducing, after said step (c), impurities into the semiconductor substrate to form a second semiconductor region of a second conductivity type; and
 - (e) introducing, after said step (c), impurities into the semiconductor substrate to form a third semiconductor region of the first conductivity type,
 - 20 the third semiconductor region being formed at a place deeper than the first semiconductor region,
 - the second semiconductor region being formed between the third semiconductor region and the first semiconductor region in the depth direction.
- 25 2. A method of fabricating a semiconductor

device according to claim 1, wherein the thermal oxide film is formed by thermal oxidation in an oxygen gas atmosphere or a water vapor atmosphere, and the deposition film is formed by a chemical vapor deposition method.

5 3. A method of fabricating a semiconductor device according to claim 1, further comprising the step of:

10 etching the top edge portion and the bottom edge portion of the trench between said step (a) and said step (b) to form the top edge portion and the bottom edge portion into gently-sloping shapes, respectively.

15 4. A method of fabricating a semiconductor device according to claim 1, further comprising the step of:

 forming a sacrifice thermal oxide film over the internal surface of the trench; and

20 removing the sacrifice thermal oxide film, said step being conducted between said step (a) and said step (b).

 5. A method of fabricating a semiconductor device according to claim 4, wherein the sacrifice thermal oxide film is formed in an oxygen gas atmosphere of 1,000°C or higher or in an oxygen gas atmosphere diluted with a nitrogen gas.

6. A method of fabricating a semiconductor device according to claim 1, wherein the deposition film is formed by a chemical vapor deposition method, the deposition film being a silicon oxide film, a
5 silicon nitride film or an acid nitride film.

7. A method of fabricating a semiconductor device according to claim 2, wherein the first semiconductor region serves as a drain region of a MISFET, the second semiconductor region serves as a
10 channel region of the MISFET, and the third semiconductor region serves as a source region of the MISFET.

8. A method of fabricating a semiconductor device according to claim 2, wherein the trench is
15 formed by etching a silicon nitride film formed on the major surface of the semiconductor substrate and the semiconductor substrate, and the silicon nitride film is removed after said step (c).

9. A method of fabricating a semiconductor
20 device comprising the steps of:

(a) etching a semiconductor substrate having a first semiconductor region of a first conductivity type which serves as a drain region, and a silicon nitride film formed over a major surface of the
25 semiconductor substrate, to form a trench from the

major surface of the semiconductor substrate in a depth direction thereof;

(b) forming a gate insulating film including a thermal oxide film and a deposition film over the internal surface of the trench;

(c) forming a gate electrode over the gate insulating film in the trench;

(d) introducing, after said step (c), impurities into the semiconductor substrate to form a second semiconductor region of a second conductivity type which serves as a channel region; and

(e) introducing, after said step (c), impurities into the semiconductor substrate to form a third semiconductor region of the first conductivity type which serves as a source region,

the third semiconductor region being formed at a place deeper than the first semiconductor region,

the second semiconductor region being formed between the third semiconductor region and the first semiconductor region in the depth direction, and

the silicon nitride film being removed at least after said step (b).

10. A method of fabricating a semiconductor device according to claim 9, further comprising the step of:

etching the top edge portion and the bottom edge portion of the trench to form the top edge portion and the bottom edge portion into gently-sloping shapes, respectively,

5 said step being conducted between said step (a) and said step (b).

11. A method of fabricating a semiconductor device according to claim 9, further comprising the step of:

10 forming a sacrifice thermal oxide film over the internal surface of the trench; and

removing the sacrifice thermal oxide film,
said step being conducted between said step (a) and said step (b).

15 12. A method of fabricating a semiconductor device according to claim 11, wherein the sacrifice thermal oxide film is formed in an oxygen gas atmosphere of 1,000°C or higher or in an oxygen gas atmosphere diluted with a nitrogen gas.

20 13. A method of fabricating a semiconductor device according to claim 9, wherein the thermal oxide film is formed by thermal oxidation in an oxygen gas atmosphere or in a water vapor atmosphere, and the deposition film is formed by a chemical vapor deposition method.

14. A method of fabricating a semiconductor device according to claim 9, wherein the silicon nitride film is removed after said step (c).

15. A method of forming a MISFET comprising
5 the steps of:

(a) etching a silicon nitride film formed over a major surface of a semiconductor substrate, and the semiconductor substrate, to form a trench from the major surface of the semiconductor substrate in a 10 depth direction thereof;

(b) forming a gate insulating film of the MISFET including a thermal oxide film and a deposition film over the internal surface of the trench; and

15 (c) forming a gate electrode of the MISFET over the gate insulating film in the trench;

the silicon nitride film being removed at least after said step (b).

16. A method of forming a MISFET according to claim 15, wherein the first semiconductor region in 20 said step (a) has a first semiconductor region of a first conductivity type which serves as a drain region,

25 after said step (c), impurities are introduced into the semiconductor substrate to form a second semiconductor region of a second conductivity type

which serves as a channel region,

after said step (c), impurities are introduced into the semiconductor substrate to form a third semiconductor region of the first conductivity type

5 which serves as a source region,

the third semiconductor region is formed at a place deeper than the first semiconductor region, and

the second semiconductor region is formed between the third semiconductor region and the first 10 semiconductor region in the depth direction.

17. A method of forming a MISFET according to claim 15, further comprising the step of:

etching the top edge portion and the bottom edge portion of the trench between said step (a) and said 15 step (b) to form the top edge portion and the bottom edge portion into gently-sloping shapes, respectively.

18. A method of forming a MISFET according to claim 15, further comprising the step of:

forming a sacrifice thermal oxide film over the 20 internal surface of the trench; and

removing the sacrifice thermal oxide film, said step being conducted between said step (a) and said step (b).

19. A method of fabricating a MISFET according 25 to claim 18, wherein the sacrifice thermal oxide film

is formed in an oxygen gas atmosphere of 1,000°C or higher or in an oxygen gas atmosphere diluted with a nitrogen gas.

20. A method of fabricating a MISFET according
5 to claim 15, wherein the thermal oxide film is formed by thermal oxidation in an oxygen gas atmosphere or in a water vapor atmosphere, and the deposition film is formed by a chemical vapor deposition method.

21. A method of fabricating a semiconductor
10 device according to claim 15, wherein the silicon nitride film is removed after said step (c).